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10/674,372

09/29/2003

Frederick Haubensak

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EXAMINER

ELVE, MARIA ALEXANDRA

ART UNIT

PAPER NUMBER

3742

MAIL DATE

DELIVERY MODE

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/674,372	Applicant(s) HAUBENSAK, FREDERICK	
	Examiner M. Alexandra Elve	Art Unit 3742	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 April 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 7, 10-23 and 25-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 7, 10-23 and 25-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 September 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 7, 14-17, 19-23 & 25-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reinhardt (USPN 6,747,243) in view of Allen et al. (USPAP 2004/0182416 A1) and Yogev et al. (USPN 6,799,584).

Reinhardt discloses a method and apparatus for selectively removing contaminant particles from a substrate (e.g. semiconductor wafer). The system scans the substrate surface to detect and identify any defects on the substrate surface and then software analyses the scanned data to determine characteristics of the defect and the planar x, y coordinates of each defect. This data is used to determine which defects should be removed. The laser uses the x, y coordinates to remove the contaminant while not substantially treating or directly contacting the area surrounding the contaminant thereby damaging or altering the substrate surface.

A femtosecond laser is used to remove the defects. The laser emits a beam having a diameter substantially the same size as a diameter of the defect in order to remove the defect. Laser beam diameters range from about 0.1 um to 0.25 um. The laser beam removing the defect at a rate that is faster than the substrate heating rate and thus avoids substrate surface damage. Defects may be removed using ablation.

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Particle size of the contaminants which are removed from the substrate having diameters as low as 0.1 μm or even lower and those contaminants having diameters up to about 0.25 μm or higher. The laser sends out pulses at 100×10^{-15} seconds, that is, it emits short pulses than last 50 to 1,000 femtoseconds and thus avoids possible surface damage to the substrate. (abstract, figures, col. 5, lines 20-62, col. 6, lines 8-22, col. 7, lines 26-33, col. 10, lines 61-67, col. 11, lines 1-50)

Reinhardt does not teach explosive evaporation, the angle of incidence or automatic alignment and focusing or the fragmentation of the contaminant.

Allen et al. discloses a method and apparatus for removing minute particles from a substrate. The apparatus tailors the energy pulses in order to remove the contaminants from the surface of a semiconductor wafer. Low pulsed laser energy density is used to remove particulate material. Explosive evaporation is used to remove particles with substantial force, that is, a thermal expansion velocity removes the particle. The pulse length of the energy and spacing of the pulses is preferably sufficiently short in order to achieve the desired temperature distribution of the energy transfer medium but not shorter in order to decrease the likelihood of substrate damage. Cleaning entails focusing the laser beam of the area of interest at approximately a 30-degree angle of incidence. The radii of particles cleaned from the surface range from 0.25 to 0.55 μm . (abstract, figures, 0002, 0005, 0009, 0010-0014, 0018, 0033, 0039, 0041, 0048, 0052-0053, 0055-0056, 0059, 0065-0066, 0068, 0074-0076, 0103)

It would have been obvious to one of ordinary skill in the art at the time of the invention to use explosive evaporation as taught by Allen et al. in the Reinhardt system because the removal technique may minimize damage to the wafer surface.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the angle of incidence (30 degrees) as taught by Allen et al., in the Reinhardt system because it ensures the optimal removal of contamination.

The provision of mechanical or automated means to replace manual activity was held to have been obvious. In re Venner 120 USPQ 192. It would have been obvious to automate alignment and focusing.

Yogev et al. discloses cleaning of particulate on semiconductor devices. The use of laser cleaning and the explosion of a particle and fragments thereof are disclosed.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use clean the fragments of particles which resulted from explosion as taught by Yogev et al. in the Reinhardt system because it is known that particles do fragment and hence cleaning is of all particles and their fragments is a function of the cleaning system.

Claims 10-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reinhardt, Allen et al. and Yogev et al., as stated above and further in view of Borden et al. (USPN 6,066,032).

Reinhardt does not teach the angle of incidence.

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Borden et al. discloses wafer cleaning using a laser and carbon dioxide snow. The wafer is sprayed with the snow/laser at a shallow angle, approximately 30° relative to the horizontal.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a shallow angle (30°) as taught by Borden et al. in the Reinhardt et al. process because this minimizes recontamination of the wafers during cleaning.

Claims 10-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reinhardt, Allen et al. and Yogev et al., as stated above and further in view of Franca et al. (USPN 6,217,422).

Reinhardt does not teach the angle of incidence.

Franca et al. discloses a laser with a grazing angle used to help remove contaminants. The incidence angle (G) is in the range of 0 to 90°, preferably 5 to 45°, more preferably 10 to 30°.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a shallow angle (30°) as taught by Franca et al. in the Reinhardt et al. process because this minimizes recontamination of the wafers during cleaning.

Claims 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reinhardt, Allen et al. and Yogev et al., as stated above and further in view of Patel (USPAP 2003/0057192A1).

Reinhardt does not specifically disclose the distance between the focal point and the work surface.

Patel discloses a laser and vacuum cleaning system. The pulsed laser focuses the beam above the surface of the workpiece causing breakdown of matter at a focused lasing point. The laser pulses are in the nanosecond to femtosecond range. The focal point is at least 2 μ m above the surface of the workpiece. More preferably, in practice the focal plane is positioned 2-10 μ m above the surface of the workpiece.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the focal distance as taught by Patel in the Reinhardt process because it ensures that the particle is specifically targeted.

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Reinhardt, Allen et al. and Yogev et al., as stated above and further in view of Vaught (USPN 5,023,424).

Reinhardt discloses detecting defects but does not specifically teach using a laser as a detector.

Vaught discloses a two laser system for particle removal. The particle position detector includes a laser light source (27) and the particle remove portion includes a second laser (51). The second laser is capable of generating a shock wave in order to remove particles.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a laser to detect defects, as taught by Vaught in the Reinhardt system because the laser is capable of detecting very small defects.

Response to Arguments

Applicant's arguments filed 4/3/09 have been fully considered but they are not persuasive.

Applicant argues that Reinhardt in view of Allen and Yogev fail to teach a particle defect to undergo an explosive evaporation. The examiner respectfully disagrees because Reinhardt discloses defect removal and laser ablation. It is well known in the art that laser ablation involves decomposition of the material in which there is an explosive reaction and vaporization. This is evidenced by Nagarkar et al. (USPN 6,485,839), as follows:

...laser ablation essentially involved ... removal of portions materials by exposing said portions to laser light of an intensity and quality (e.g., wavelength) sufficient to completely or partly decompose said material. The reaction can be fairly characterized as "explosive" (i.e., on a microscopic level), producing vapor-like or gas-like streams consisting of fragments of the removed material. (col. 2, lines 18-26)

Applicant argues that Allen et al. does not teach explosive evaporation. The examiner respectfully disagrees because Allen discloses: *Explosive evaporation is used to remove particles with substantial force, that is, a thermal expansion velocity removes the particle.*

Applicant argues that Yogev et al. does not teach explosive evaporation. The examiner respectfully disagrees because Yogev et al. discloses: *use of laser cleaning and the explosion of a particle and fragments thereof.*

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to M. Alexandra Elve whose telephone number is 571-272-1173. The examiner can normally be reached on 7:30-4:00 Monday to Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tu B. Hoang can be reached on 571-272-4780. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

June 28, 2009.

/M. Alexandra Elve/
Primary Examiner, Art Unit 3742